



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of

ANTHONY J. KONECNI ET AL.

Serial No. 08/988,686 (TI-22166)

Filed December 11, 1997

For: PLASMA PRE-TREATMENT TO REMOVE RESIDUES FORMED IN A VIA

Art Unit 2822

Examiner M. Wilczewski

Commissioner for Patents  
Washington, D. C. 20231

Sir:

**REPLY BRIEF**

In replt to the Examiner's Answer, it is initially noted that Issue 1 has been withdrawn as a ground of rejection, leaving only Issues 2 and 3 to be discussed.

As to this appeal and to the references applied, the law clearly states that this appeal is an appeal of the final or second rejection (35 U.S.C. 134(a)) and the prior art of record is the English language prior art only as set forth in the final or second rejection. Any additional reinterpretation or alteration of the final rejection or any prior art or translation not of record in the final rejection involves a new rejection and is therefore not an issue before this Board.

As to Issues 2 and 3, in general, it is noted that an important feature of the present invention is the fact that, since higher ion energies are not required by the process of the present invention, the present invention reduces or eliminates the undesirable deformation of high aspect

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ratio features or topologically sharp features often associated with modern semiconductor devices. In accordance with this feature of the invention and to avoid the above-mentioned problems, the plasma has a plasma power of from about 150 watts to about 450 watts and preferably up to about 300 watts and at a temperature of from about 100°C to about 450°C. These ranges are nowhere demonstrated in the references of record in conjunction with the cleaning steps of the method herein.

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As to Issue 2, claims 21 to 26, 29 and 30 were rejected as being unpatentable over Japanese Patent No. 4-171,744 of Masanori in view of the Takeyasu et al. publication under 35 U.S.C. 103(a). The rejection is without merit insofar as can be determined from the abstract of the European counterpart of this reference (an English language abstract or translation of the Japanese reference is not of record according to the file of appellant).

As stated in the Brief on Appeal, a principal inventive feature set forth in the claims on appeal relates to the step of removing residue from the opening by providing a halogen-free gas comprised of hydrogen incorporated within a plasma into the opening in the insulating layer and onto the exposed portion of the first conductive layer to increase the reactive surface of any residual material on the exposed portion and at least partially remove the residual material and then depositing a conductive material into the opening using chemical vapor deposition. The advantage of this type of chemistry is set forth on page 5 of the specification which is that high ion energies are not required, thereby reducing or eliminating the undesirable deformation of high aspect ratio features or topologically sharp features often associated with modern semiconductor devices. A review of the Japanese patent clearly indicates that the chemistry used is the undesirable prior art halogen chemistry mentioned in the subject specification, fluorine (F) and fluorides being halogen chemistry. Note again in the Abstract of the Japanese patent (the

incorrect, even in abstract

copy from the European Patent Office) that fluorine (F) as well as hydrofluoric acid (HF) are present, these being a halogen and a halogen-containing material (a halide) respectively. These halogen materials did not suddenly appear from nowhere and it must therefore be assumed that they are a part of the chemistry involved based upon the reference of record. If these materials were present during the cleaning operation, then they would be a part of the plasma involved, especially since the hydrofluoric acid (HF) is clearly stated to be evaporated and is therefore in the gaseous state. This cannot be cavalierly explained away when it is clearly present. In addition, the use of a hydrogen plasma chemistry is nowhere taught or even remotely suggested in the Japanese patent abstract. Only an argon plasma is mentioned. It follows that the inventive concept of the claims on appeal is nowhere taught or even remotely suggested by the cited reference since halogens are clearly present and are not explained away in the reference of record. It follows that when the principal reference teaches the use of halogen chemistry as a part of the procedure, there is no basis whatsoever to combine this chemistry with non-halogen chemistry and specifically hydrogen chemistry since there is no teaching or suggestion to do so. It follows that, even were Takeyasu et al. to teach or suggest that which it is alleged to teach, there would be no teaching or suggestion to combine the references. Furthermore, the above noted teaching is nowhere taught or suggested by Takeyasu et al. in any event.

As previously stated, claims 22 to 26, 29 and 30 depend from claim 21 and therefore define patentably over the Japanese patent, Takeyasu and any proper combination of these references for at least the reasons set forth above with reference to claim 21.

Claim 26 further limits claim 21 by requiring that the plasma have a plasma power of from about 150 watts to about 450 watts. No such combination is taught or suggested by the Japanese patent, Takeyasu and any proper combination of these references. The Examiner's

Answer states that this is a processing parameter which would have been obvious to optimize. However, there is no teaching in the cited Japanese reference to operate at such power levels and the alleged optimization and reasons therefore are nowhere supported in the reference of record and are supported in the specification of the subject application. As stated in the specification, a purpose of the present invention is to be able to operate a lower ion energies to reduce or eliminate the undesirable deformation of high aspect ratio features or topologically sharp features (paragraph bridging pages 4 and 5). This advantage is nowhere mentioned in the cited references and there is therefore no basis for the "general and broad conclusion" drawn in the Examiner's Answer. In re Thrift et al., slip opinion page 12 (01-1445) (CAFC 2002).

⇒ that is why 103 combination is made in independent claim

Claims 29 and 30 further limit claims 21 and 26 by requiring that the step of providing a gas into the opening be at a temperature of from about 100°C to about 450°C. No such combination is taught or suggested by the Japanese patent, Takeyasu and any proper combination of these references. The argument presented above with reference to claim 26 applies as well to this rejection.

With reference to Issue 3, claims 27, 28, 31 and 32 were rejected under 35 U.S.C. 103(a) as being unpatentable over the Japanese Patent 4-171,744 in view of Takeyasu et al further in view of Pam (U.S. 6,008,139). The rejection is without merit since all of these claims depend from claims 21, 26, 27 and 28 respectively and therefore define over the cited references for at least the reasons presented above with reference to claims 21 and 26 since Takeyasu et al. and Pam fail to overcome the deficiencies in the Japanese patent as above enumerated.

In addition, claims 27 and 28 further limit claim 21 and 26 by requiring that the plasma have a bias power of up to about 300 watts. No such combination is taught or suggested by the Japanese patent, Tekeyasu et al., Pam or any proper combination of these references in the

cleaning environment of the present invention. The argument presented above with reference to claims 21 and 26 also applies and is incorporated herein by reference.

Claims 31 and 32 further limit claims 27 and 28 by requiring that the step of providing a gas into the opening be at a temperature of from about 100°C to about 450°C. No such combination is taught or suggested by the Japanese patent, Takeyasu et al., Pam or any proper combination of these references in the cleaning environment of the present invention. The argument presented above with reference to claims 21 and 26 also applies and is incorporated herein by reference.

### **CONCLUSIONS**

For the reasons stated above as well as in the Brief on Appeal, reversal of the final rejection and allowance of the claims on appeal is requested that justice be done in the premises.

Respectfully submitted,



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